53 ~~94~~. A method of viewing the image of an electro-optical display device from different viewing angles in the range Θ = 10° - 60° and observing a small dependence of image contrast on viewing angle in said range, comprising viewing at different angles Θ in said range the image of the electro-optical display device of claim 36.

54 ~~95~~. A method of viewing the image of an electro-optical display device from different viewing angles in the range Θ = 10° - 60° and observing a small dependence of image contrast on viewing angle in said range, comprising viewing at different angles Θ in said range the image of the electro-optical display device of claim 50.

55 ~~96~~. A method of viewing the image of an electro-optical display device from different viewing angles in the range Θ = 10° - 60° and observing a small dependence of image contrast on viewing angle in said range, comprising viewing at different angles Θ in said range the image of the electro-optical display device of claim 51.

REMARKS

Breakthrough Nature of the Claimed Invention

Attached documents (Exhibits 1 and 2; Items 13 of attached Table 3 and 29 of attached Table 2, respectively) make indisputable that the invention of this application is a major advance in liquid crystal display technology, actually a major breakthrough. This can be seen from Exhibit 1 alone which contains the relevant pages from Information Display 12/96 wherein the invention has received the SID "Display of the Year Award" for 1996. These awards have "immediately been accepted as major international industry awards in 1995 - the first year they were awarded." Note page 13, which contains the actual text of the award, referring to it as a "major change in TFT-LCD panel architecture," which it attributes specifically to the in-plane-switching (IPS) effect claimed in this application (i.e., switching an image in a display surface under control of an electric field having a component predominantly parallel to the surface). The "impressive technology" finally makes it possible for LCD technology to replace CRT technology in many applications, such as monitors for desk-top computers. (It will be noted that the award refers to a specific product of Hitachi (a 13.3" LCD monitor), whereas this application is assigned to Merck GmbH. Hitachi is the

primary licensee of Merck under this series of U. S. applications.) See also Exhibit 2 which is a paper from EuroDisplay '96 authored by Hitachi which, in the first paragraph, specifically refers to "the Baur group," i.e., the inventors of this application, for the IPS invention and its heretofore-unachievable wide viewing angle characteristics (i.e., low dependence of image contrast on viewing angle). (See Items 1-4 of Table 2 which are the same as References 1-4 of Exhibit 2.)

Exhibit 3 from Nikkei Electronics Asia of March 1996 (Item 12 of Table 2) is another article from the Hitachi group. It contains color photographs dramatically establishing the high superiority of the viewing characteristics of the displays of this invention versus state-of-the-art displays before this invention. See Figure 1. See also Figure 2 which explains the significant superiority in terms of the invention claimed in this application. Note especially the passage under the heading, "Striving to Beat CRTs." It emphasizes the reason LCD displays have not been able to replace CRTs for applications such as desktop monitors, i.e., they were unable to achieve viewing angle independency "equivalent to that of CRTs." It concludes:

> [This problem], however, proved vexing and extremely difficult to resolve with conventional technology. There was no obvious approach.
>
> Super TFT Technology [IPS] offered a way to solve the viewing angle problem, clearing the last performance barrier.

On the same note, see also Exhibit 4 (Information Display 3/96; Item 5 of Table 3) where the author is summarizing the EID '95 show. All three figures of the article relate to the IPS invention. Figure 1 again dramatically illustrates the freedom from viewing angle dependence of the picture quality (e.g., contrast). Figure 2 does the same thing in graphical terms. Figure 3 explains the remarkable viewing angle characteristics in terms of the invention claimed in this application. Finally, see the second and third to last paragraphs of the article describing the new displays as "a veritable star of the show" and as possessing "impressive characteristics."

Like any other pioneer invention, that of this application is now being adopted by the field as a whole. Chinnock (Exhibit 8; Item 11, Table 3), reporting on NEC devices, indicates in Fig. 2 the latter's adoption of the IPS technology. A paper from Hoshiden

Corporation (Exhibit 9; Item 30 of Table 2) shows its adoption of the same technology. See also Exhibit 10 (Item 12 of Table 3) and its English translation (Exhibit 11). The first paragraphs of the latter two articles confirm the significant obstacle posed by poor viewing angle characteristics of LCD displays for their use in larger display area applications. The articles as a whole conclude that the IPS invention of this application solves this longstanding problem. See the last paragraphs of each article which refer to there being essentially no limit in the viewing angle of the invention from a practical perspective. The first of these articles (Matsumoto et al.; Exhibit 9) is especially interesting since it specifically acknowledges that the subject IPS technology is that of this application. See its second sentence which cites reference no. 3, the initial report of the Baur invention of this application (Item 1 of Table 2) and reference No. 4 which is a report of subsequent IPS work of Hitachi (Item 17 of Table 2). (Reference No. 1 (Shimajo) of Matsumoto et al. is also attached; as can be seen, it does not relate at all to IPS.) Note also that Matsumoto et al. states: "An in-plane-switching (IPS) LCD [1,2] has recently been revived . . . " As will be explained below, the "revived" nature of this invention independently further establishes the non-obviousness of the invention. Finally, attention is directed to the colored version of Figure 9 of Matsumoto et al. which once again dramatically illustrates the viewing angle independence achieved by IPS.

See also the attached Table 1 (Exhibit 5) which lists a collection of competitors' patent applications and patents related to the IPS invention. See also Table 2 (Exhibit 6) which lists a number of papers and presentations on IPS and Table 3 (Exhibit 7) which lists a number of articles discussing IPS. Should the examiner desire to see copies of any of the listed publications, in addition to those provided herewith as a sampling, the undersigned will be happy to oblige.

The Claims

The fact that the solution provided by this invention to the difficult problem of achieving good viewing angle characteristics for LCD displays remained undiscovered for almost two decades alone suggests it is non-obvious and thus patentable. This is an enormous time span in the rapidly developing field of electro-optic displays such as LCDs. In fact, it is a highly non-obvious invention. Such an invention clearly warrants

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appropriately broad claims reflective of its breakthrough nature. Thus, the claims of this application mirror the broadest definitions of the invention in the specification. In view of the guidance provided by this application, suitable combinations of display parameters can routinely be determined for any display of interest, perhaps in conjunction with routine optimization experiments. For example, see Exhibits 9 and 10 where Hoshiden specifically describes the "optimization" of one such parameter, the pretilt angle, α_0. See, e.g., the second full paragraph on Page 4 of Exhibit 11, the translation of Exhibit 10.

Independent Claims 20 and 90 recite the range defined in the application for one of the important parameters, pretilt angle α_0. Independent Claim 84 reflects the invention by reciting a pretilt angle and an orientation angle β_0 which achieve the unobvious effects discussed in the specification. ("Improved image contrast" is clearly part of the invention since a small viewing angle dependence of contrast inherently involves an improvement in its contrast.) As mentioned above, in view of the guidance of the application, nothing more than routine optimization is required to select combinations of α_0 and β_0 to achieve the recited effect(s). Independent Claim 85 is the same as claim 84 except it recites the term "reduce" instead of "prevent." The former is not explicitly mentioned in the specification but clearly is inherent therein in view of the overall tenor of the specification relating to improving contrast characteristics. A skilled worker would necessarily know that lessening domain formation was clearly within the scope of the disclosure and in the possession of the inventors. *Kennecott v. Kyocera*, 5 U.S.P.Q.2d 1194 (Fed. Cir. 1987); *VasCath v. Makurkar*, 19 U.S.P.Q.2d 1111 (Fed. Cir. 1991).

Claim 89 defines the invention in an alternative fashion, referring to possession of "an initial state configuration" which achieves the effects disclosed in the specification. See page 18, lines 6-10. The rationale is analogous to that for Claims 84 and 85.

The various α_0 values recited in Claims 20-35 are supported in the specification, either explicitly or inherently, since they are subsumed in the explicitly disclosed α_0 ranges, e.g., $0° \leq \alpha_0 < 30°$ and $0° \leq a_0 \leq 5°$, and, thus, are clearly part of the invention. See, e.g., *In re Wertheim*, 191 U.S.P.Q. 90 (C.C.P.A. 1976), *McLaughlin v. Roberts*, 197 U.S.P.Q. 831 (P.O.B.A. 1978) and many others. The exclusionary language of Claims 37 and 81 is supported under *In re Johnson*, 194 U.S.P.Q. 187 (C.C.P.A. 1977), especially in view of the fact that the mentioned values are inherently disclosed because they are subsumed

in ranges mentioned in the application, as explained above. See *Wertheim*, etc., *supra*. The recitation of thin film transistors in Claim 77 is inherent in view of the disclosure of a transistor matrix in combination with the nature of the disclosed device designs. The term "image spot" used in the specification and claims is a synonym for "pixel." The comparisons recited in Claims 86-88 are based upon the figures and are not indefinite. See, *Andrew v. Gabriel*, 6 U.S.P.Q.2d 2010 (Fed. Cir. 1988) holding that expressions such as "approach each other", "substantially equal", and "closely approximate" are not indefinite since skilled workers would know what is intended in context. With respect to claim 88, see Exhibit 12 which is a mark-up of Fig. 7 demonstrating the inherency of the recited feature. See *VasCath*, *supra*, holding that original figures provide written description for features they show. Finally, method claims 93-96 especially clearly reflect the advantageous properties of the invention and distinguish the prior art.

New Figures 2a and 2b are the same as those entered during parent prosecution and illustrate the claimed features of electrodes in two planes and a matrix array.

The Prior Art

It is believed self-evident that the prior art neither anticipates nor renders obvious the claimed invention; otherwise it would have been used decades ago to achieve the long sought low dependence of contrast on viewing angle.

The Soref References

There are three Soref literature references of record. These relate to work performed at the Sperry Rand Research Center in developing a liquid crystal display system and switching element based on a construction having a component of the electric field predominantly parallel to the substrate, i.e., surface of the liquid crystal layer. The time frame of these references is 1973-1974. Thus, over two decades ago Soref first introduced the parallel field based switching system.

These references probably are the basis for the description in the above-discussed Exhibit 9 to the "revived" parallel-field systems. Why was a revival necessary? Most probably because all of the prior art which discussed such a system failed to realize that appropriate selection of its parameters (e.g., α_0, β_0, etc.) could provide the very effects

which the field spent almost two decades trying to achieve, e.g., superior viewing angle characteristics.

For example, Soref is silent as to the parameter, pretilt angle α_0. (The phrase "molecules initially oriented parallel to the plates as illustrated in Figure 3" in Soref, JAP, Page 5467, Column 1, first paragraph, clearly refers to the homogeneous orientation of that figure and not to pretilt angle.) Furthermore, it is not possible by repeating the Soref experiments to determine what the pretilt angle was. This is at least because the particular commercial nematic mixtures used by Soref (see, e.g., Column 1 of the Proceedings of the IEEE) are no longer available and their compositions are not publicly known. However, from the orientation treatment described in Soref (Proceedings of the IEEE: 80 Å film of silicon monoxide deposited at 85° incidence), it appears that pretilt angles would likely be greater than 30°. This is consistent with Soref not having achieved good viewing angle properties since α_0 values under 30° are important for such characteristics. In any event, no definite values of α_0 less than 30° are established by Soref. Thus, the claims of this application reciting specific values of α_0 and/or advantageous viewing angle properties are novel over Soref.

Regarding another parameter mentioned in the specification, orientation angle β_0, Soref states that its selection is "arbitrary" (Column 1, last line) and conducts several experiments using specified values. Most importantly, Soref's conclusion regarding his experiments is: "the optical contrast ratio and the angular field-of-view are approximately the same as in the conventional twisted-nematic displays." Not only were the angular field-of-view characteristics of TN displays poor in Soref's day but, as established above based on several of the Exhibits, up until the invention of this application, they remained poor. Clearly, none of the devices disclosed in the Soref references meet the requirements of this invention because none achieved the properties of this invention. In fact, it is the deficient viewing angle properties of TN systems (including those of Soref) that this invention dramatically and nonobviously improves.

As can be seen, the claims of this invention are novel and nonobvious over the Soref references. Note Figure 7 of the specification which demonstrates the invention's independence of transmission and contrast on viewing angle. Its superiority over present -

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day conventional TN displays, which are already significantly improved over those of Soref's days, is clear in view of comparative Figure 8.

The Rejections

In view of the foregoing discussion, it is respectfully submitted to be clear that the references cited by the examiner with respect to the previously existing claims are not relevant. *Mizuno et al.* relate only to the normal TN display types where switching is achieved by a perpendicular field, not a parallel one. *Masubuchi* (and *Aviram,* relied on in the parent) do involve systems where the electric field has a component predominantly parallel to the substrate. However, there is nothing in either reference which indicates that any conditions are selected to meet the language of the claims or achieve the results of this invention. Reference is again made to the exhibits being filed herewith which attest to the fact that such properties were heretofore unachievable. The various subsidiary aspects for which the examiner relies on *Gelber et al.*, *Wada et al* and *Haas et al.*, are irrelevant to the patentability of the claims.

The above sentiments made with respect to *Mizuno* and *Aviram* apply analogously to the other references of record relating to systems having electric fields parallel to the liquid crystal layer. In particular, these references fail to specify values of parameters such as α_0, either numerically or by provision of sufficient detail in terms of liquid crystal compositions and/or orientation layers or treatments to explicitly or inherently disclose such values. This is clear in view of the dormancy of the parallel electric field switching mechanism for about two decades, necessitating its "revival" by this invention, not only to bring it back into existence, but, as clearly established above, to create a major breakthrough in LCD technology.

The several Japanese and DDR publications for which English translations are being provided were uncovered in a search focusing on in-plane (parallel) fields in LCD devices.

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As can be seen from the foregoing discussion, all claims are novel and nonobvious over all references of record.

Respectfully submitted

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